

UL TEST REPORT AND PROCEDURE

Standard:	UL 62368-1, 2nd Ed, 2014-12-01 (Audio/video, information and communication technology equipment Part 1: Safety requirements) CAN/CSA C22.2 No. 62368-1-14, 2nd Ed, Issued: 2014-12-01 (Audio/video, information and communication technology equipment Part 1: Safety requirements)
Certification Type:	Component Recognition
CCN:	QQJQ2, QQJQ8 (Power Supplies for Use in Audio/Video, Information and Communication Technology Equipment)
Complementary CCN:	N/A
Product:	Switching power supplies and accessory racks
Model:	<p>Single Power Supply Modules:</p> <p>1) FPS1000-48xz, -32xz, -24xz, -12xz (x = "/P", "/S", "/PS, /POE", blank; z=/CO, blank)</p> <p>2) RFE1000-48xz, -32xz, -24xz (x = "-Y", blank; z=/CO, blank)</p> <p>Empty Racks:</p> <p>3) FPS-S1Uxy (x = "/P", "/S", "/PS" "/TB", blank; y-/CO, blank)</p> <p>4) FPS-T1Uxy (x = "/P", "/S", "/PS", blank; y=/CO, blank)</p> <p>Triple Power Supply Modules (based on FPS-S1U empty rack):</p> <p>5) FPS3000-48x, -32x, -24x or -12x (x= "/P", "/S", "/PS", "/TB", blank)</p>
Rating:	<p>1) FPS1000-48xz, -32xz, -24xz, -12xz:</p> <p>1.a) x= "/S", "/POE", blank;</p> <p>Input: 100-240 Vac, 13-6.3 A, 50/60 Hz;</p> <p>Output:</p> <p>[-48 @ T=50°C]: V1 = 48 Vdc, 21 A; V2 = 12 Vdc, 0.25 A; [-48 @ T=70°C]: V1 = 48 Vdc, 11.55 A; V2 = 12 Vdc, 0.25 A; [-32 @ T=50°C]: V1 = 32 Vdc, 31 A; V2 = 12 Vdc, 0.25 A; [-32 @ T=70°C]: V1 = 32 Vdc, 17.05 A; V2 = 12 Vdc, 0.25 A; [-24 @ T=50°C]: V1 = 24 Vdc, 40 A; V2 = 12 Vdc, 0.25 A; [-24 @ T=70°C]: V1 = 24 Vdc, 22 A; V2 = 12 Vdc, 0.25 A; [-12 @ T=50°C]: V1 = 12 Vdc, 72 A; V2 = 12 Vdc, 0.25 A; [-12 @ T=70°C]: V1 = 12 Vdc, 39.6 A; V2 = 12 Vdc, 0.25 A;</p> <p>1.b) x= "/P", "/PS";</p> <p>Input: 100-240 Vac, 13-6.3 A, 50/60 Hz;</p> <p>Output:</p> <p>[-48 @ T=50°C]: V1 = 48 Vdc, 21 A; V2 = 12 Vdc, 0.25 A; [-48 @ T=60°C]: V1 = 48 Vdc, 16.8 A; V2 = 12 Vdc, 0.25 A; [-32 @ T=50°C]: V1 = 32 Vdc, 31 A; V2 = 12 Vdc, 0.25 A; [-32 @ T=60°C]: V1 = 32 Vdc, 24.8 A; V2 = 12 Vdc, 0.25 A; [-24 @ T=50°C]: V1 = 24 Vdc, 40 A; V2 = 12 Vdc, 0.25 A; [-24 @ T=60°C]: V1 = 24 Vdc, 32 A; V2 = 12 Vdc, 0.25</p>

A; [-12 @ T=50°C]: V1 = 12 Vdc, 72 A; V2 = 12 Vdc, 0.25 A; [-12 @ T=60°C]: V1 = 12 Vdc, 57.6 A; V2 = 12 Vdc, 0.25 A

2) RFE1000-48xz, -32xz, -24xz:

Input= 100-240 Vac, 13-6.3 A, 50/60 Hz;

Output:

[-48 @ T=50°C]: V1 = 48 Vdc, 21 A; V2 = 12 Vdc, 0.25 A; [-48 @ T=70°C]: V1 = 48 Vdc, 11.55 A; V2 = 12 Vdc, 0.25 A; [-32 @ T=50°C]: V1 = 32 Vdc, 31 A; V2 = 12 Vdc, 0.25 A; [-32 @ T=70°C]: V1 = 32 Vdc, 17.05 A; V2 = 12 Vdc, 0.25 A; [-24 @ T=50°C]: V1 = 24 Vdc, 40 A; V2 = 12 Vdc, 0.25 A; [-24 @ T=70°C]: V1 = 24 Vdc, 22 A; V2 = 12 Vdc, 0.25 A;

3) FPS-S1Uxy:

Input: 100-240Vac, 39-18.9 A, 50/60 Hz per unit, for full rack.

Output:

[-48 @ T=50°C]: V1 = 48 Vdc, 63 A; V2 = 12 Vdc, 0.75 A; [-48 @ T=70°C]: V1 = 48 Vdc, 34.66 A; V2 = 12Vdc, 0.75 A; [-32 @ T=50°C]: V1 = 32 Vdc, 93 A; V2 = 12Vdc, 0.75 A; [-32 @ T=70°C]: V1 = 32 Vdc, 51.15 A; V2 = 12Vdc, 0.75 A; [-24 @ T=50°C]: V1 = 24 Vdc, 120 A; V2 = 12Vdc, 0.75 A; [-24 @ T=70°C]: V1 = 24 Vdc, 66 A; V2 = 12Vdc, 0.75 A; [-12 @ T=50°C]: V1 = 12 Vdc, 216 A; V2 = 12Vdc, 0.75 A; [-12 @ T=70°C]: V1 = 12 Vdc, 118.8 A; V2 = 12Vdc, 0.75 A.

4) FPS-T1Uxy:

Input: 100-240 Vac, 13-6.3 A, 50/60 Hz per unit, up to 3 units;

Outputs (per each installed unit):

[-48 @ T=50°C]: V1 = 48 Vdc, 21 A; V2 = 12 Vdc, 0.25 A; [-48 @ T=70°C]: V1 = 48 Vdc, 11.55 A; V2 = 12 Vdc, 0.25 A; [-32 @ T=50°C]: V1 = 32 Vdc, 31 A; V2 = 12 Vdc, 0.25 A; [-32 @ T=70°C]: V1 = 32 Vdc, 17.05 A; V2 = 12 Vdc, 0.25 A; [-24 @ T=50°C]: V1 = 24 Vdc, 40 A; V2 = 12 Vdc, 0.25 A; [-24 @ T=70°C]: V1 = 24 Vdc, 22 A; V2 = 12 Vdc, 0.25 A; [-12 @ T=50°C]: V1 = 12 Vdc, 72 A; V2 = 12 Vdc, 0.25 A; [-12 @ T=70°C]: V1 = 12 Vdc, 39.6 A; V2 = 12 Vdc, 0.25 A;

5) FPS3000-48x, -32x, -24x or -12x:

Input: 100-240Vac, 39-18.9 A for /TB only and 13-6.3 each input, 50/60 Hz for full rack;

Outputs:

[-48 @ T=50°C]: V1 = 48 Vdc, 63 A; V2 = 12V dc, 0.75A; [-48 @ T=60°C]: V1 = 48 Vdc, 50.4 A; V2 = 12V dc, 0.75A; [-32 @ T=50°C]: V1 = 32 Vdc, 93 A; V2 = 12V dc, 0.75A; [-32 @ T=60°C]: V1 = 32 Vdc, 74.4 A; V2 = 12V dc, 0.75A; [-24 @ T=50°C]: V1 = 24 Vdc, 120 A; V2 = 12V dc, 0.75A; [-24 @ T=60°C]: V1 = 24 Vdc, 96 A; V2 = 12V dc, 0.75A. [-12 @ T=50°C]: V1 = 12 Vdc, 216 A; V2 = 12V dc, 0.75A; [-12 @ T=60°C]: V1 = 12 Vdc, 172.8 A; V2 = 12V dc, 0.75A

Applicant Name and Address:

TDK-LAMBDA CORP
NAGAOKA TECHNICAL CENTER

R&D DIV
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NAGAOKA-SHI
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This is to certify that representative samples of the products covered by this Test Report have been investigated in accordance with the above referenced Standards. The products have been found to comply with the requirements covering the category and the products are judged to be eligible for Follow-Up Service under the indicated Test Procedure. The manufacturer is authorized to use the UL Mark on such products which comply with this Test Report and any other applicable requirements of UL LLC ('UL') in accordance with the Follow-Up Service Agreement. Only those products which properly bear the UL Mark are considered as being covered by UL's Follow-Up Service under the indicated Test Procedure.

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Prepared By: Robert Dmitruk / Project Handler Reviewed By: Michał Siudowski / Reviewer

Supporting Documentation

The following documents located at the beginning of this Procedure supplement the requirements of this Test Report:

A. Authorization - The Authorization page may include additional Factory Identification Code markings.

B. Generic Inspection Instructions -

- i. Part AC details important information which may be applicable to products covered by this Procedure. Products described in this Test Report must comply with any applicable items listed unless otherwise stated in the body of this Test Report.
- ii. Part AE details any requirements which may be applicable to all products covered by this Procedure. Products described in this Test Report must comply with any applicable items listed unless otherwise stated in the body of each Test Report.
- iii. Part AF details the requirements for the UL Certification Mark which is not controlled by the technical standard used to investigate these products. Products are permitted to bear only the Certification Mark(s) corresponding to the countries for which it is certified, as indicated in each Test Report.

Product Description

All products are Class I, designed for Over voltage Category II and Pollution Degree 2.

Equipment mobility: FPS1000 and RFE1000 power supplies, FPS-S1Uxy, FPS-T1Uxy and FPS3000 are for build-in, in addition the FPS-S1Uxy, FPS-T1Uxy and FPS3000 are rack-mounting.

Model Differences

1. FPS1000 units:

- Basic power supply module-without an AC inlet and secondary communication option;
- Followed by "/S"-with communication circuit (ES1 circuit);
- Followed by "/P"-with AC inlet located on the front panel;
- Followed by "/PS"-with both options listed above.
- * Followed by "/POE"- same as FPS1000-48 except Y-cap to ground, C152, C153 (0.01uF, 250V).
- Followed by "/CO"-with conformal coating (used for environmental protection only)

* The PSU followed by POE has no relevant safety changes/additions.

RFE1000 units (modified FPS1000 units):

- Basic power supply module-without an "or-ing" diodes in the ES1 output;
- Followed by "-Y"-with "or-ing" diodes in the ES1 output to allow parallel connection of units.
- Followed by "/CO"-with conformal coating (used for environmental protection only)

2. Accessory Rack FPS-S1U, intended for installation of up to three FPS1000-xx units:

- Basic model: with 3 AC inlets on the rear side and common main and auxiliary outputs;
- Followed by "/P"-without AC inlets on the rear side (for installation of power supply modules with an
- Followed by "/TB" -for option with common AC input terminal block:

3. Accessory Rack FPS-T1U, intended for installation of up to three FPS1000 units:

- Basic model: with three AC inlets on the rear side and separate main and auxiliary outputs for each installed unit;
- Followed by "/P"-without AC inlets on the rear side (for installation of power supply modules with an appliance inlet on the front panel)
- Followed by "/S"-with secondary communication option (in ES1 circuit);

- Followed by "/PS"-with both options listed above
- Followed by "/CO"-with conformal coating (used for environmental protection only)

4. Power Supply FPS3000: accessory rack model FPS-S1U or FPS-T1U with three installed FPS1000 units.

- Basic model-with three AC inlets on the rear side;
- Followed by "/P"-without AC inlets on the rear side (for installation of power supply modules with an appliance inlet on the front panel)
- Followed by "/S"-with secondary communication option (in ES1 circuit);
- Followed by "/PS"-with both options listed above
- Followed by "/TB"-with common AC input terminal block.

Test Item Particulars

Classification of use by	Ordinary: for front-panel only (see GPI1).
Supply Connection	AC Mains
Supply % Tolerance	+10%/-10%
Supply Connection – Type	pluggable equipment type A - non-detachable supply cord appliance coupler pluggable equipment type B - non-detachable supply cord mating connector See GPI1
Considered current rating of protective device as part of building or equipment installation	20 or 60 (see GPI1) A; building; equipment
Equipment mobility	movable for building-in rack-mounting
Over voltage category (OVC)	OVC II
Class of equipment	Class I
Access location	restricted access area
Pollution degree (PD)	PD 2
Manufacturer's specified maximum operating ambient (°C)	see GPI1
IP protection class	IPX0
Power Systems	--
Altitude during operation (m)	3000 m
Altitude of test laboratory (m)	2000 m or less
Mass of equipment (kg)	max. 2kg (FPS1000, RFE1000 power units), max. 10kg (FPS-T1U and FPS-S1U populated racks), max. 10 kg (FPS3000 power supplies)

Technical Considerations

- The product was submitted and evaluated for use at the maximum ambient temperature (T_{ma}) permitted by the manufacturer's specification of : 50°C@ 100%, or less of rated output for all units; 60°C at 80% or less of rated output for FPS1000 units with appliance inlet; accessory racks FPS-S1U, FPS-T1U and FPS3000 triple power supplies not followed by TB; 70°C@ 55% or less output power for FPS1000 units without appliance inlet
- The product is intended for use on the following power systems : TN, TT
- Considered current rating of protective device as part of the building installation (A) : 60A for FPS-S1U/.../TB, FPS-T1U/.../TB and FPS3000-xx/.../TB, 20A for all other units

- Mains supply tolerance (%) or absolute mains supply values : +10%/-10%
- The equipment disconnect device is considered to be : - for FPS1000 units followed by /P, /PS, /P/POE, /PS/POE, FPS-T1U(-T1U/P), FPS-S1U blank or followed by /P and FPS3000 blank or followed by /P - appliance coupler(s); , - For FPS1000 units blank or followed by /S, /POE, S/POE, RFE1000 units, FPS-S1U/TB and FPS3000/TB have not disconnect device provided with unit. An appropriate disconnect device shall be provided by end-product.
- The Risk Group of a lamp or lamp system (including LEDs) is : Exempt
- The following are available from the Applicant upon request : User Guide provided
- Classification of use by: Ordinary (for front-panel only), Instructed person and Skilled person.
- Supply connection:
 - For pluggable equipment type A:
 - Non-detachable supply cord for - FPS-S1Uxy followed by /TB, FPS-T1Uxy followed by /TB, FPS3000 followed by /TB and RFE1000
 - Appliance coupler for - FPS1000 single power supply modules (followed by /P or /PS), FPS-S1Uxy without suffix /TB, FPS-T1Uxy without suffix /TB
 - For pluggable equipment type B:
 - Non-detachable supply cord for - FPS-S1Uxy followed by /TB, FPS-T1Uxy followed by /TB, FPS3000 followed by /TB and RFE1000 single power supply modules
 - Permanent connection for - FPS-S1Uxy followed by /TB, FPS-T1Uxy followed by /TB, FPS3000 followed by /TB and RFE1000
 - Mating connector for - FPS1000 single power supply modules
- Due to altitude factor for 3000m, required clearances were multiplied by 1.14.

Engineering Conditions of Acceptability

For use only in or with complete equipment where the acceptability of the combination is determined by UL LLC. When installed in an end-product, consideration must be given to the following:

- The following product-line tests are conducted for this product : Earthing Continuity, Electric Strength
- The end-product Electric Strength Test is to be based upon a maximum working voltage of : Primary-Secondary: 695 Vrms/359 Vpk, Primary – Earthed Dead Metal: 416 Vrms/780 Vpk
- The following output circuits are at ES1 energy levels : The main outputs (48VDC, 32VDC, 24VDC or 12VDC and auxiliary output (12VDC)
- The following output circuits are at PS2 energy levels : Auxiliary output (12VDC)
- The following output circuits are at PS3 energy levels : main outputs (48VDC, 32VDC, 24VDC or 12VDC)
- The maximum investigated branch circuit rating is : FPS-S1U/.../TB, FPS-T1U/.../TB and FPS3000/.../TB B: 60A, all other units: 20A.
- The investigated Pollution Degree is : 2
- Proper bonding to the end-product main protective earthing termination is : Required, For FPS1000, FPS3000 series power supplies and accessory racks FPS-S1U and FPS-T1U designed by TDK-Lambda: the products shall be properly bonded to the protective earth termination in the end-product., For RFE1000, the products shall be properly bonded by screw through the end-equipment's chassis to the power supply chassis, that would connect the power supply to an electrical ground
- An investigation of the protective bonding terminals has : been conducted
- The following end-product enclosures are required : Electrical and Fire enclosure shall be provided for FPS1000, RFE1000, Mechanical enclosure shall be provided for FPS1000, Electrical and Fire enclosure shall be provided Power supplies FPS3000 and Accessory racks FPS-S1U, FPS-T1U.
- The following magnetic devices (e.g. transformers or inductor) are provided with an OBJY2 insulation system with the indicated rating greater than Class A (105°C) : T101, T102 and T103 (Class F)
- The equipment is suitable for direct connection to : Accessory racks FPS3000 followed by /TB and FPS-T1U followed by /TB are connected to AC mains by means of a single terminal block and from there the supply is distributed to each FPS1000 unit. Accessory racks FPS3000, FPS-S1U and FPS-T1U without suffix /TB are provided with a connection to the AC mains for each FPS1000 unit separately by means of a standard appliance inlet.
- The power supply was evaluated to be used at altitudes up to : 3000 m

Additional Information

The FPS1000-48xz, -32xz, 24xz and -12xz (FPS1000 series) is a family of front-end (component) power supplies for built-in use. All units provide a handle on front side for plugging/unplugging the unit to/from the rack. Rear side contains a connector with AC pins, output DC pins and signal pins. Only the front side is accessible to ordinary person.

FPS1000 with suffix /P or /PS units contains a standard appliance inlet at front panel.

The FPS1000 series intended for accessory racks. The FPS1000 units may be used in the complete set of the accessory racks FPS-S1U, FPS-T1U or separately from TDK-Lambda designed accessory racks, in accordance with the "Additional application considerations".

RFE1000-48xz, -32xz, -24xz or -12xz (RFE1000 series) is a family of front-end (component) power supplies for built-in use, which is the same as the FPS1000 series and have minor differences due to using of separate input terminal block (TB) on the rear panel only, separate signals connectors and output bus-bars instead of common I/O connector which used in the modules. RFE1000 is power supply series units intended to use separately from TDK-Lambda designed accessory racks.

For RFE1000 and FPS1000 series units used separately from TDK-Lambda designed accessory racks, the means of connection to the mains shall be specified in end-installation.

Accessory racks FPS-S1U and FPS-T1U are intended for using with up to three FPS1000 power supply modules, In the FPS-S1U and FPS3000 units all outputs are connected in parallel. In FPS-T1Uxy units, each output is separated from the other.

Accessory racks FPS3000 followed by /TB and FPS-T1U followed by /TB connected to AC mains by single terminal block and from there distributor to each FPS1000 unit. Accessory racks FPS3000, FPS-S1U and FPS-T1U without suffix /TB provided connection to the AC mains for each FPS1000 unit separately by standard appliance inlet.

FPS1000 units followed by /P or /PS, the accessory racks FPS-S1U (not followed by /TB), FPS-T1U and FPS3000 units (without suffix /TB) are Pluggable Type A.

FPS1000, RFE1000, FPS-S1U (followed by /TB) and FPS3000 (followed by /TB) units: type of connection to the AC mains shall be specified in end-product.

All outputs considered ES1 and separated by reinforced insulation from primary mains. Outputs are unearthed and may or may not be earthed during product installation

Disconnect Device:
appliance coupler(s):
FPS1000 units followed by /P or /PS, FPS-T1U,
FPS-S1U (not followed by /TB)
FPS3000 (not followed by /TB)

Without disconnect device:
FPS1000 and RFE1000 units followed by /S, -48/POE, -48/S/POE
RFE1000 units followed by /S, -48/POE, -48/S/POE
FPS3000 units (followed by /TB)
(An appropriate disconnected device shall be provided by end-product.)

For the FPS1000, RFE1000 series power supplies an appropriate Electrical and Fire Enclosure shall be provided in the end product.

For the FPS-S1U and FPS-T1U accessory racks designed by TDK-Lambda, and FPS3000 series triple power supplies an appropriate Electrical and Fire enclosure shall be provided in the end product.


The FPS1000, FPS3000, RFE1000 series power supplies and accessory racks FPS-S1U and FPS-T1U designed by TDK-Lambda should only be installed in a Restricted Access Area. Access should be available to service personnel only.

Additional Standards

The product fulfills the requirements of: UL 60950-1, 2nd Edition, Revised October 14, 2014, CSA CAN/CSA-C22.2 No. 60950-1 2nd Edition, Revised October 14, 2014

Markings and Instructions

Clause Title	Marking or Instruction Details
Equipment identification marking – Manufacturer identification	Listee's or Recognized companys name, Trade Name, Trademark or File Number
Equipment identification marking – model identification	Model Number
Equipment rating marking – ratings	"Input Ratings (voltage, frequency/dc, current/power)", "Output Ratings (voltage, frequency/dc, current/power)"

<p>Class I equipment -Terminal for main protective earthing</p>	<p>Provided adjacent to the main protective earthing terminal</p>  <p>(IEC 60417-5019)</p>
<p>Disconnect device - Permanently connected equipment</p>	<p>Statement indicating that an appropriate disconnect device shall be incorporated in the building installation wiring. (Instruction)</p>
<p>Safety Instructions - Rack Mount</p>	<p>"Rack Mount Instructions - The following or similar rack-mount instructions are included with the installation instructions: A) Elevated Operating Ambient - If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer. B) Reduced Air Flow - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised. C) Mechanical Loading - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading. D) Circuit Overloading - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern. E) Reliable Earthing - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips)."</p>
<p>Special Instructions to UL Representative</p> <p>Inspect the Transformer (T101, T102 and T103) listed in Electric Strength Test Special Constructions. When the tests are conducted at other location, inspect Test Record and Specification Sheet provided by the component manufacturer.</p> <p>Verify the Specification Sheet indicates 100% routine test specified in Electric Strength Test Special Constructions be conducted at the component manufacturer.</p>	

BD1.0							TABLE: Production-Line Testing Requirements						
BD1.1							Electric Strength Test Special Constructions – Refer to Generic Inspection Instructions, Part AC for further information.						
Model	Component	Removable parts	Test probe location	Test V rms	Test V dc	Test Time, s							
All	T101, T102 and T103	-	input to output	4000	4000	1							
BD1.2							Earthing Continuity Test Exemptions – This test is not required for the following models:						
							N/A						
BD1.3							Electric Strength Test Exemptions – This test is not required for the following models:						
							N/A						
BD1.4							Electric Strength Test Component Exemptions – The following solid-state components may be disconnected from the remainder of the circuitry during the performance of this test.						
							-						

BE1.0							Sample and Test Specifics for Follow-Up Tests at UL						
Model	Component	Material	Test	Sample (s)	Test Specifics								
N/A	-	-	-	-	-								